

ASSESSMENT AND FORECASTING OF TRAFFIC FLOW ENTERING THE HISTORICAL CITY OF KHIVA

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Abstract

In this article, the speed of traffic of motor vehicles entering the historical city of Khiva from 4 national highways during peak hours of the day has been experimentally studied. Based on the obtained results, the average annual daily traffic speeds were determined, and the average annual daily traffic speeds in the next 10 years were predicted using mathematical formulas, and proposals and recommendations were developed to improve the traffic flow.

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Introduction

Nowadays, speeding up traffic is one of the most urgent problems in any developing cities. In recent years, as a result of the rapid increase in the volume of traffic in the historical city street network, the capacity of the streets has decreased, the speed of vehicles has decreased, traffic jams have occurred at most single-level intersections, and such situations have led to an increase in fuel consumption of vehicles, loss of time for passengers, it also leads to the aggravation of a number of economic, social, ecological, sanitary-hygienic situations, such as the increase of waste gases and traffic noise.

The main quality indicators of historical city streets are traffic safety, ease of movement, and economy of movement. These indicators, in turn, determine the load level of the city street-road network, i.e., the ratio of the speed of the road to its carrying capacity. The speed of city streets refers to the total number of vehicles that pass through a certain section of the road in a unit of time [1].

Historically, cities were formed at the intersection of trade routes and were major transportation hubs. Every city has transport connections with other cities, and the larger the city, the greater the traffic density and the number of such connections. The most difficult problem is connecting external roads with cities and districts.

Due to the increase in traffic speed, traffic flows and as a result of long-standing at intersections, traffic jams, excessive pollution, and increased noise levels, delays in public transport due to the violation of

public transport schedules, as well as an increase in traffic accidents have become urgent issues. Along with other cities, in Khiva, the search for a modern solution to the evaluation of the flow of traffic entering and leaving the city, the development of transport infrastructure, and the development of the road network remain relevant. Today, there are 6 national and 2 local roads leading to the city [2].

Inflow into cities is the unit of motor vehicles (vehicles/hour or units/day) that come to the city from cities and districts by means of motor vehicles, working population, internal and external tourism, business trips, activities and other factors.

Materials and methods

In the city of Khiva, which is considered one of the historical cities of the Republic of Uzbekistan, the traffic speed in the street network is planned to be developed using the models developed and applied by many scientific research institutes in the analysis of the results of experimental research and determination using mathematical formulas [3- 20].

The main factors leading to congestion in the city's main street network are the unequal or small amount of inbound and outbound vehicle flows. Experimental studies conducted in July 2023 during peak hours of the day for 2 hours on public highways by visually counting the number of vehicles entering and leaving the city around 08⁰⁰ – 10⁰⁰ in the morning. It was conducted by video surveillance at noon 12⁰⁰ – 14⁰⁰ and in the evening 17⁰⁰ – 19⁰⁰ [21].

Many professors of the Tashkent State Transport University have conducted studies on determining the speed of traffic on public roads. When taking into account the daily speed of movement by eye, it is determined using the following formula based on clause 2.7 of MQN 45-2007 [1]:

$$N_{\text{суткa}} = N_{\text{coat}} * K_{\text{y}} (I)$$

here K_{y} - coefficient of transition from hourly traffic speed to average daily traffic speed (Appendix 6).

The daily speed of movement is determined using the K_{y} - coefficients of formula 1 in Appendix 6. After determining the daily traffic speed, we can determine the average daily traffic speed using the following formula:

$$N_{\text{yр.сут}} = \sum_{i=1}^n \frac{N_{\text{сут}}}{n} \dots \dots \dots (2)$$

where n is the number of measurements during movement accounting for n -day.

The amount of flow entering the city of Khiva was determined using formula 1, the values given for light vehicles in Table 1.3, and then the average annual daily traffic speed was determined using formula 2.

The average annual daily traffic speed is found by the following formula:

$$N_{\text{yр.йил.сут}} = N_{\text{сут}} * K_{\text{й}} \dots \dots \dots (3)$$

here $K_{\text{й}}$ coefficient of transition from the average daily traffic speed to the average annual traffic speed (Appendix 7).

Average annual vehicle traffic is used only when comparing economic ledgers based on options and determining capital efficiency.

Future prospective average annual daily traffic volume of vehicle traffic is determined on the basis of economic research data. In the absence of necessary data on cargo and passenger flows, the average annual daily traffic speed can be determined as follows [22]:

$$N_{\text{cc}} = N_0 (1 + \alpha)^t \dots \dots \dots (4)$$

here N_0 – the average annual daily traffic speed determined as a result of experimental research on the road network (pieces/day);

α - the annual growth rate of movement is 0.05 on average, as it is a rapidly developing city;

t- movement speed in the future forecast period.

Results

As a result of the conducted natural experiments, the following was determined (Fig. 1).

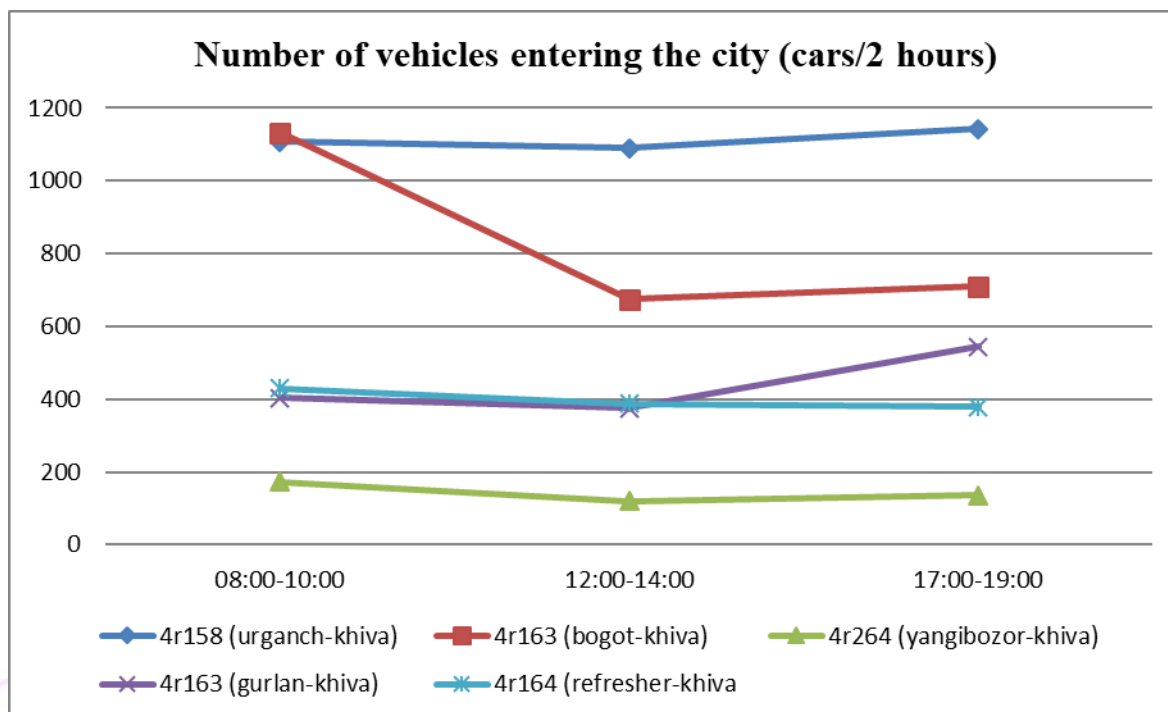


Figure 1. Number of vehicles entering the city of Khiva (cars/2 hours)

It can be seen from Figure 2 that the upper part of the flow entering the city of Khiva comes from the 4r158 (Urgan-KHiva) highway, mainly during the evening peak, the flow is higher than in the morning, and during the afternoon, the flow is found to be much less than in the morning or evening.

On the highway 4r163 (Bogot-Hiva), the flow entering the city during the morning rush hour was much larger than in the afternoon and evening.

The lowest rate was observed on the highway 4r264 (Yangibozor-Hiva) even during peak hours of the day.

Results of experimental studies conducted in June (Table 1).

Table 1. Number of vehicles entering the city of Khiva (cars/2 hours)

№	The name of the roads	traffic flow sheet									
		Taken into account time	up to 2 tons	from 2 tons to 5 tons	from 5 tons to 8 tons	more than 8 tons	trailer and semi-trailer	bus	trolleybus	motorcycles and mopeds	light vehicle
1	4r158 (Urganch-KHiva)	8:00-10:00	60	8	4	2	7	8	0	6	1012
		12:00-14:00	86	30	8	8	0	4	0	2	952
		17:00-19:00	58	12	14	4	12	14	0	12	1016
2	4r163 (Bogot-KHiva)	8:00-10:00	64	26	12	18	2	10	0	12	1008
		12:00-14:00	36	20	21	11	1	7	0	11	567

		17:00-19:00	35	21	12	12	0	6	0	11	613
3	4r163 (Gurlan-KHiva)	8:00-10:00	2	6	4	4	0	0	0	4	384
		12:00-14:00	5	0	6	1	0	1	0	8	354
		17:00-19:00	19	12	3	4	0	8	0	7	491
4	4r264 (Yangibozor-KHiva)	8:00-10:00	4	0	2	10	2	3	0	6	146
		12:00-14:00	5	1	1	0	0	2	0	3	108
		17:00-19:00	0	0	6	0	0	2	0	10	118
5	4r164 (Refresher-KHiva)	8:00-10:00	28	18	6	0	2	6	0	10	360
		12:00-14:00	24	14	8	2	1	6	0	4	328
		17:00-19:00	15	7	8	4	0	5	0	5	334

Taking into account the above, a table of conversion to a light car mile was created by entering formulas into the Excel program [23] based on the source (table 1).

Table 2. Information on light vehicles of vehicles entering the city of Khiva

№	The name of the roads	Coefficients for light motor vehicles according to item 140 of the Commercial Code 2.07.01-03										
		taken into account time	light vehicle r	up to 2 tons	from 2 tons to 5 tons	from 5 tons to 8 tons	more than 8 tons	trailer and semi-trailer	bus	trolleybus	motorcycles and mopeds	Total number of vehicles delivered
				1,5	2	2,5	3	3,5	2,5	3	0,5	
1	4r158 (Urganch-KHiva)	8:00-10:00	1012	60	8	10	6	24,5	20	0	3	1144
		12:00-14:00	952	129	60	20	24	0	10	0	1	1196
		17:00-19:00	1016	87	24	35	12	42	35	0	6	1257
2	4r163 (Bogot-KHiva)	8:00-10:00	1008	96	52	30	54	7	25	0	6	1278
		12:00-14:00	567	54	40	52,5	33	3,5	17,5	0	5,5	773
		17:00-19:00	613	52,5	42	30	36	0	15	0	5,5	794
3	4r163 (Gurlan-KHiva) 4r264 (Yangibozor-KHiva)	8:00-10:00	384	3	12	10	12	0	0	0	2	423
		12:00-14:00	354	7,5	0	15	3	0	2,5	0	4	386
		17:00-19:00	491	28,5	24	7,5	12	0	20	0	3,5	587
4	4p264 (Янгибозор-Хива)	8:00-10:00	146	6	0	5	30	7	7,5	0	3	205
		12:00-14:00	108	7,5	2	2,5	0	0	5	0	1,5	127
		17:00-19:00	118	0	0	15	0	0	5	0	5	143
5	4r164 (Refresher-KHiva)	8:00-10:00	360	42	36	15	0	7	15	0	5	480
		12:00-14:00	328	36	28	20	6	3,5	15	0	2	439
		17:00-19:00	334	22,5	14	20	12	0	12,5	0	2,5	418

After calculating the average speed of movement by formula 2, we find the average annual daily speed of movement (Table 3).

Table 3. Data on the average annual daily speed of the flow of motor vehicles entering the city of Khiva

№	The name of the roads	taken into account time	Total number of vehicles delivered	K_y – coefficient 1 formula	Daily movement speed	Total daily traffic speed	average speed of motion formula 2	$K_{\text{ж}}$ – coefficient for June	Average annual daily traffic volume (units/day)
							n=3		
1	4r158 (Urganch-KHiva)	8:00-10:00	1144	8,28	9472	30761	10254	0,99	10151
		12:00-14:00	1196	8,74	10453				
		17:00-19:00	1257	8,62	10835				
2	4r163 (Bogot-KHiva)	8:00-10:00	1278	8,28	10582	24182	8061	0,99	7980
		12:00-14:00	773	8,74	6756				
		17:00-19:00	794	8,62	6844				
3	4r163 (Gurlan-KHiva)	8:00-10:00	423	8,28	3502	11936	3979	0,99	3939
		12:00-14:00	386	8,74	3374				
		17:00-19:00	587	8,62	5060				
4	4r264 (Yangibozor-KHiva)	8:00-10:00	205	8,28	1697	4040	1347	0,99	1333
		12:00-14:00	127	8,74	1110				
		17:00-19:00	143	8,62	1233				
5	4r164 (Refresher-KHiva)	8:00-10:00	480	8,28	3974	11414	3805	0,99	3767
		12:00-14:00	439	8,74	3837				
		17:00-19:00	418	8,62	3603				

Based on the parameters shown in Table 3, the average annual daily speed of the flow of motor vehicles entering the city of Khiva was determined. This is of great importance in forecasting the promising solutions of the road network of future state importance with the help of defined parameters.

One of the main characteristics of the traffic flow is the speed of movement, which determines the importance of the road, its geometric elements, the condition of the traffic flow, the service life of the pavement, the required durability of the road surface, the level of organization of traffic, the financing of the road service, etc.

When we take the value of the growth rate for the future $(1 + \alpha)^t$ for the 10th year, the result is 1.63.

Based on formula 4, we take the value of N_0 . from table 3 and forecast it in order to calculate the expected average annual traffic speed of the highways of state importance entering the city in the future.

Object 1. We determine the expected average traffic speed of the 4r158 (Urganch-Hiva) highway in the next 10 years:

$$N_{10}=10151*1,63=16546 \text{ units/day}$$

Object 2. We determine the expected average traffic speed of the 4r163 (Bogot-Hiva) highway in the next 10 years:

$$N_{10}=7980*1,63=13008 \text{ units/day}$$

Object 3. We determine the expected average traffic speed of the 4r163 (Gurlan-Hiva) highway in the next 10 years:

$$N_{10}=3939*1,63=6421 \text{ units/day}$$

Object 4. Let's determine the expected average traffic speed of the highway 4r264 (Yangibozor-Hiva) in the next 10 years:

$$N_{10}=1333*1,63=2173 \text{ units/day}$$

Object 5. Let's determine the expected average traffic speed of the highway 4r164 (new exhaust-hiva) for the next 10 years:

$$N_{10}=3767*1,63=6141 \text{ units/day}$$

Figure 3 shows the expected average annual traffic speed of vehicles entering the city of Khiva in the next 10 years.

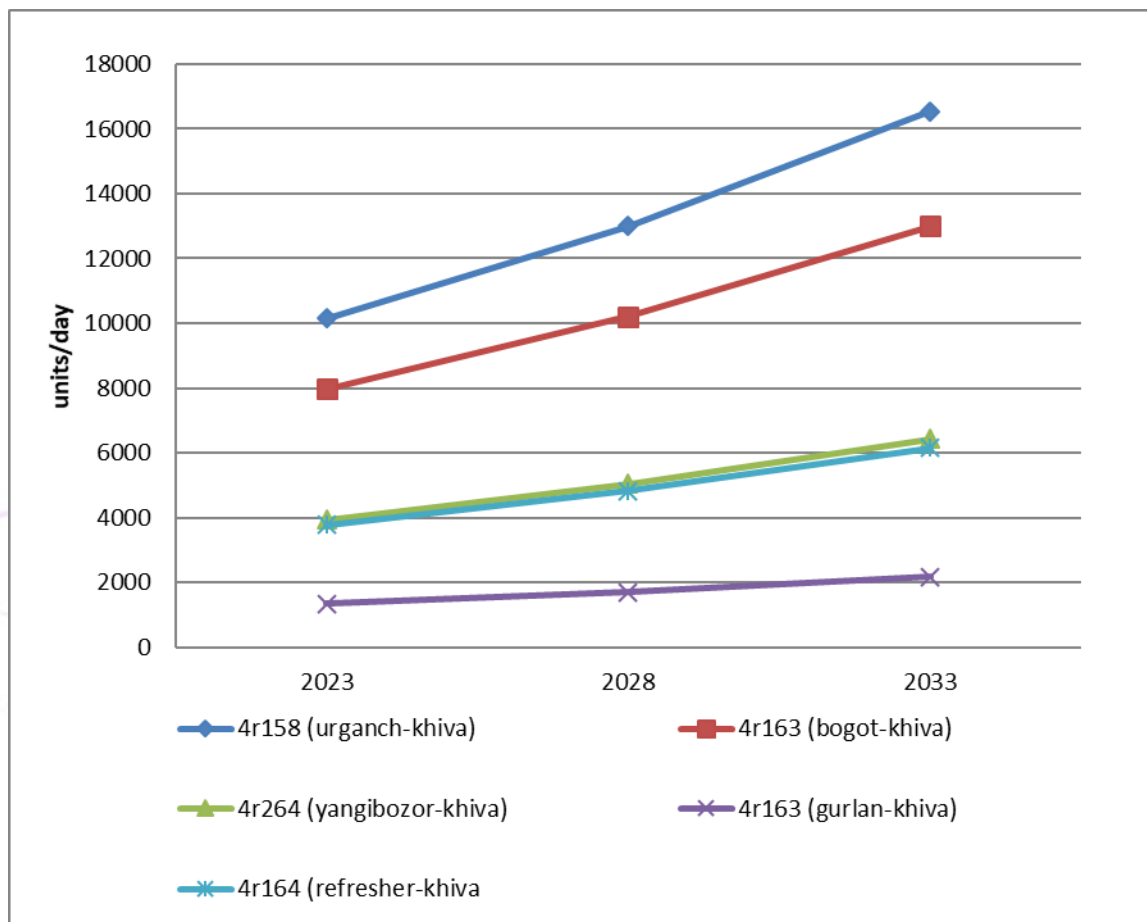


Figure 3. Prospective average annual traffic volume of motor vehicles entering the city of Khiva

Conclusion

It is necessary to take into account the following suggestions and recommendations in order to properly organize the flow of motor vehicles entering the city of Khiva:

Development of a new bypass project adjacent to the access roads to the city;

Establishment of new overpasses at city entrances;

Improvement of design solutions of transport nodes at city entrances;

Development of measures to increase traffic lanes on the roads at the entrance to the city.

Reference

1. MQN 45-2007, "Manual on calculating the speed of vehicles on highways", Tashkent 2007, 84 pages.
2. Qutliev A.A., Usmanov Q.T., "STUDY OF THE MAIN INDICATORS OF TRANSPORT ACTIVITY

IN THE CITY OF HIVA" // INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCE "INNOVATIVE METHODS OF ENSURING HUMAN SAFETY ON ROADS". Tashkent 2023. pp. 149-158.

3. Организация динамической маршрутизации транспортных потоков// Методическое руководство: Министерства транспорта Российской Федерации, Москва 2017г,56с.
4. Маликов М.А., Сайдаметова Ф.Ж. АНАЛИЗ СЕТИ ГОРОДСКИХ ДОРОГ И УЛИЦ (НА ПРИМЕРЕ ГОРОДА УРГЕНЧ) // Universum: технические науки : электрон. научн. журн. 2023. 1(106).
5. ЗЕДГЕНИЗОВ А.В. ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ДОРОЖНОГО ДВИЖЕНИЯ НА ОСТАНОВОЧНЫХ ПУНКТАХ ГОРОДСКОГО ПАССАЖИРСКОГО ТРАНСПОРТА// АВТОРЕФЕРАТ,Иркутск 2008,20с.
6. И.А. Бахирева, Н.Ю. Кармадонова, Я.А. Черниченко, А.М. Танатова. Определение пропускной способности улиц и дорог с применением беспилотных летательных аппаратов.
7. Igor A. Bakhirev, Natalya Yu. Karmadonova, Yaroslava A. Chernichenko, and Anna M. Tanatova. 2019. "Determination of the Throughput Capacity of Streets and Roads Using Unmanned Aerial Vehicles." *Journal «Izvestiya Vuzov. Investitsiyi. Stroyitelstvo. Nedvizhimost»* 9(2):384–95. doi: 10.21285/2227-2917-2019-2-384-395.
8. Л. В. Булавина, "Расчет Пропускной Способности Магистралей И Узлов," 2009.
9. Безопасность движения в городах: материалы V Рос.-Герм. конф. по безопасности дорожного движения (Иркутск, 21 – 22 июня 2010 г.). Иркутск: Изд-во ИрГТУ, 2010. - 163 с.
<http://transport.istu.edu/downloads/net1.pdf>.
10. Е. И. Ананьев, Ф. В. О. Тгту, Н. Ю. Залукаева, Ф. В. О. Тгту, Е. Ananев, "ОРГАНИЗАЦИЯ ОДНОСТОРОННЕГО ДВИЖЕНИЯ КАК МЕТОД УВЕЛИЧЕНИЯ ПРОПУСКНОЙ СПОСОБНОСТИ УЛИЧНО-ДОРОЖНОЙ СЕТИ ГОРОДА А ONE-WAY MOVEMENT AS A METHOD OF INCREASING THE CAPACITY OF THE CITY ' S STREET NETWORK," *Transp. Bus. Russ.*, vol. №5, pp. 136–139, 2017.
11. М. N. Kripak and O. A. Lebedeva, "Оценка состояния улично - дорожной сети крупного города," vol. 3, no. 51, pp. 171–174, 2016.
12. В. В. Ширин, "ПОВЫШЕНИЕ ПРОПУСКНОЙ СПОСОБНОСТИ УЛИЧНО - ДОРОЖНОЙ СЕТИ ГОРОДА МЕРЕЖИ МІСТА INCREASE OF TRAFFIC CAPACITY OF URBAN ROAD NET V . Shirin , assistant , KhNANU," *Вестник ХНАДУ*, pp. 40–47, 2010.
13. Е. А. Румянцев, "Транспорт СОВЕРШЕНСТВОВАНИЕ МЕТОДОВ ОЦЕНКИ УСЛОВИЙ ДВИЖЕНИЯ ТРАНСПОРТНЫХ ПОТОКОВ НА ГОРОДСКОЙ УЛИЧНО - ДОРОЖНОЙ СЕТИ Транспорт," vol. 9, no. 68, pp. 148–151, 2012.
14. "Ученый xxi века," vol. 4, no. 18, pp. 35-38, 2016.
15. В.В. Морозов, С.А. Ярков. ВЛИЯНИЕ ЗАНЯТОСТИ ПОЛОСЫ НА ИНТЕНСИВНОСТЬ ДВИЖЕНИЯ ТРАНСПОРТНЫХ СРЕДСТВ// Транспорт 2017,25-29с.
16. МЕТОДЫ УЧЕТА ИНТЕНСИВНОСТИ ДВИЖЕНИЯ ТРАНСПОРТНОГО ПОТОКА// ГОСТ 32965-2014, Москва 2019,26с.
17. Е. С. Краснов, С. С. Семенов, and Н. Ю. Михайлов, "Проектирование и строительство дорог," no. 3, pp. 72–84, 2017, doi: 10.15593/2409-5125/2017.03.05.
18. "И.Б.Хошимов. *J. Innov. Sci. Educ. Res.*, vol. 2, no. 13, pp. 154–157, 2022.

19. *А.Ю.Михайлов. НАУЧНЫЕ ОСНОВЫ ПРОЕКТИРОВАНИЯ УЛИЧНО-ДОРОЖНЫХ СЕТЕЙ// АВТОРЕФЕРАТ, Москва 2004,38с.*
20. Letter No. 10/16-3474 of the ИБ ЖХХ УХХ Department of Khorezm region.
21. G.A. Fedatova. PROEKTIROVANIE AVTOMOBILEYX DOROG// Spravochnik injinera-doroznika: Transport, Moscow 1989g, 439s.
22. ShNQ 2.07.01-03 "Urban planning. Planning the development and construction of urban and rural settlements" Tashkent-2009, pp. 81-88, 2009.

